

rostratum, and *Catherinea undulata*, withstood 8–20 weeks in dry air and 5–13 weeks in the desiccator; and in species from the drier coniferous woods, like *Bartramia ityphylla*, *Dicranum fuscescens*, and *D. scoparium*, the resistance to dry air extended to 50 weeks and in the desiccator to 40 weeks. It should be noted that after all the leaves were thus killed, many of the plants were still capable of growth by fresh shoots from the more resistant stems.

The leaves of soil-growing mosses showed drought resistance in the desiccator for periods varying from 3 weeks for *Physcomitrium pyriforme*, 7 weeks for *Bryum pallens*, and 9 weeks for *Funaria hygrometrica*, to 15 weeks for *Bryum argenteum* and 35 weeks for *Pottia lanceolata*. Rock-inhabiting species included remarkably resistant forms, as *Grimmia pulvinata*, enduring 60 weeks of exposure in the desiccator, and *Schistidium apocarpum*, with one-fourth of its leaf cells still alive after 128 weeks of continuous exposure to dry air. Species from tree trunks showed resistance of the same order as those from the rocks.

Field observations show that alternate wetting and rapid drying are more detrimental in their effects than continuous drought; also, that the same species growing under different conditions varies in its drought resistance, the more hardy being that from drier habitats. Protonemata were correspondingly variable, withstanding the action of the desiccator for periods varying from 2 weeks for the cultivated protonema of *Funaria hygrometrica*, whose natural grown protonema was twice as resistant, to 14 and 15 weeks for the natural growing protonema of *Bryum argenteum* and *Catharina undulata*. The sporophytes were found to be almost as hardy as the protonemata.

Experimental evidence from a large number of species points to great uniformity in the power of resisting cold. At -20° C. the leaves of most species were killed, whether they came from the aquatic, mesophytic, or xerophytic habitats, although in a few species the resistance extended to -30° C. Plants grown at a high temperature showed decidedly less resistance to sudden cold than those from cooler situations. Attention is also directed to the relation between turgor and the freezing point of the leaf cells, and to the behavior of the cells in various solutions.

The evidences of careful methods, the large number of species under experimentation, the abundance of the quantitative data, and the logical organization of the report are to be commended.—GEO. D. FULLER.

Composition and qualities of coal.—By improved methods of making thin coal sections, JEFFREY²³ claims to have obtained new and valuable results in the study of the composition of coal. In a brief discussion of the modes of accumulation he holds the view that at present both the accumulation as the result of heaping up of the remains of successive generations of plants in peat bogs, the autochthonous hypothesis, and the accumulation by drift in lakes or lagoons, the allochthonous hypothesis, commonly take place in the temperate

²³ JEFFREY, EDWARD C., On the composition and qualities of coal. *Econ. Geol.* 9:730–742. 1915.

climates; but that only the method of accumulation by drift takes place in the tropical climates, nothing corresponding to a peat bog of the temperate climates having been found in the tropics. As the result of microscopic examination of coal he concludes that the allocthonous hypothesis also harmonizes best with the structure of coal. This is in harmony with the view of some that the climate of the coal-forming epochs approached present tropical conditions.

The canneloid coals, such as the true cannel coals, tasmanite, and boghead coals, are composed chiefly of spores, now very much crinkled and collapsed, imbedded together with some woody material in a dark ground substance. Hitherto many of these bodies had been considered gelatinous algae, but owing to improved methods can now be identified as spores. These coals have been formed under open water, representing the muck of ancient lakes or lagoons.

The ordinary bituminous coals are composed of both woody or lignitoid material and spore or canneloid matter in varying proportions. The woody or lignitoid constituent, known in descriptive terminology as glanz coal, is found in layers and has lost completely its original organization, a condition generally observed in coals derived from vegetable débris. Carbonized wood or charcoal is the only material derived from the grosser parts of plant bodies which retain structure in coal. Between the shiny woody or lignitoid layers are lodged the duller canneloid layers, known in descriptive terminology as matt coal, consisting of a dark ground substance in which are imbedded remains of flattened spores.

Coals, therefore, may be composed of three recognizable constituents: (1) spores or canneloid, (2) modified wood or lignitoid, and (3) less commonly relatively unmodified carbonized wood or charcoal. The properties of coal, he conjectures, depend to a very large degree upon the proportions of the original constituents; coals rich in spores, such as cannels, bogheads, and oil shales, are highly bituminous, and in some form or other are the mother substance of oil and gas. The spore contents of a coal determine the fatness, and in all probability have a definite relation to its coking properties; the lignitoid constituent, on the other hand, reduces the bituminosity and coking value of coal.—REINHARDT THIESSEN.

Self-sterility in *Nicotiana*.—EAST²⁴ has studied self-sterility in hybrids between *Nicotiana forgetiana* (Hort.) Sand. and *N. alata* Lk. and Otto. var. *grandiflora* Comes. The parent plants were both self-sterile, though self-fertile plants occur in at least one of the parent species. All the hybrids tested (over 500 plants of F_1 , F_2 , F_3 , and F_4) were self-sterile. The F_1 plants, like the parent species, had 90–100 per cent of morphologically perfect pollen, except for a single plant with only 2 per cent of good pollen. Cross-pollination between individual plants of F_2 , F_3 , and F_4 demonstrated a high degree of cross-fertility. There was found 1.5 per cent of apparent cross-sterility in F_2 , 6 per

²⁴ EAST, E. M., The phenomenon of self-sterility. Amer. Nat. 49:77–87. 1915.